

REMARKS

Applicants have amended claims 9 and 11-13 and added new claims 15-17. The amendments to claims 9 and 11-13 correct minor English matters and do not narrow claim scope. In addition, the amendments to claims 9 and 13 somewhat broaden claim scope by eliminating the requirement “at the same time,” which is recited in new claims 15 and 17 depending from claims 9 and 13, respectively.

Claims 9-12 have been rejected under 35 USC 102(b) as anticipated by U.S. Patent No. 5,811,871 (Nakashima). Applicants respectfully traverse this rejection.

Claim 9 recites forming a base region of a first conducting type on a surface of a collector layer of a second conducting type and also recites forming a base electrode layer on a surface of the base region and forming an insulating film on a surface of the base electrode layer. In other words, first the base region having a conductivity type different from that of the collector layer is formed in the collector layer, and then the base electrode layer and the insulating film are formed on the base region that has been already formed in the collector layer. Applicants point out that the expression “a base region of a first conducting type on a surface of a collector layer of a second conducting type” denotes not only a geometrical position of the semiconductor substrate but also the formation of the base region that has a conductivity type different from that of the collector layer. Since the base region is necessarily first formed by the claimed method on the collector layer of the semiconductor substrate prior to the formation of other layers on the surface of the collector layer, the depth of the base region is accurately controlled.

The Examiner contends that Nakashima’s FIGS. 4 and 30-43, especially FIG. 41, describe the claimed formation of the base region, the base electrode layer and the insulating film. The Examiner says that external base layer 30 corresponds to the claimed base region, epitaxial

growth layer 4 corresponds to the claimed collector layer, and polysilicon layer 15 and CVD oxide film 31 correspond to the claimed base electrode layer and insulating film, respectively. However, in Nakashima's processing steps, the base electrode layer 15 is first formed on the collector layer 4 of N type, which has not yet had the base region of P type formed thereon, and then the base region of P type is formed by implanting impurities through the base electrode layer 15 and oxide film 28. See column 2, lines 15-29, of Nakashima. Therefore, the depth control of the base region 30 becomes difficult, and thus Nakashima requires the formation of intrinsic base layer 34 of P type in addition to the formation of the base region 30. See column 2, lines 31-36, of Nakashima. On the other hand, the method of claim 9 first forms the base region in the collector layer and then forms the base electrode layer and the insulating film on the base region formed in the collector layer. Accordingly, the depth control of the base region is accurate and the claimed method does not require additional formation of the P type layer to work as the base, such as the one required in Nakashima.

Applicants also point out that Nakashima does not teach or suggest the formation of the γ -shaped trench of claim 10. The specification defines the " γ -shaped trench" as having a bottom portion narrower than the top portion (page 12, lines 3-11). Even though the formation of the side wall reduces the width of the emitter region formed at the bottom of the trench, forming the trench itself into the γ -shape further reduces the emitter width and thus contributes to the reduction of the parasitic capacitance. See, for example, page 12, lines 20-24, of the specification. On the other hand, the trench formed in step 32, which the Examiner equates to the claimed trench, is a straight trench and not the γ -shaped trench of claim 10.

Nakashima does not teach or suggest the claimed formation of the base region, the base electrode layer and the insulating film or the claimed γ -shaped trench. Thus, the rejection of claims 9-12 on Nakashima should be withdrawn.

Claims 13 and 14 have been rejected under 35 USC 102(b) as anticipated by U.S. Patent No. 5,79,285 (Yoshihara). Applicants respectfully traverse this rejection.

Claim 13 recites doping impurities of the second conducting type so that a doped region is formed around the trench and in the base electrode layer. In other words, one doping step is enough to provide impurities to both the region around the trench and the base electrode layer because the doping is performed after the formation of the trench, as claimed. The Examiner contends that Yoshihara's FIGS. 2 and 3A-3K describe the manufacturing method of claim 13, including the claimed doping step of the second conducting type impurities. Applicants respectfully disagree.

In Yoshihara's processing steps, polysilicon layer 43, which the Examiner equates to the claimed base electrode layer, is doped before the formation of the trench. See column 4, lines 45-53 and FIG. 3D, of Yoshihara. Because forming the trench removes the impurity-doped base electrode layer from the region for the subsequent base region formation, the same impurities as those of the base electrode layer, boron ions, must in Yoshihara processing steps be doped again into the bottom of the trench to form boron diffusion source 84. Accordingly, Yoshimura does not teach or suggest the single doping step of the impurities after the trench formation of claim 13.

Additionally, Yoshihara does not teach or suggest the formation of the γ -shaped trench of claim 14. As is the case with Nakashima, Yoshimura describes only the formation of a straight trench and not the γ -shaped trench as claimed.

New claims 15 and 17 recite the requirement that the base electrode and the emitter electrode are formed at the same processing step, which was recited in the corresponding original dependent claims and removed from the independent claims as unduly narrowing claim scope. New claim 16 finds support, for example, at page 13, lines 18-26, of the specification and FIG. 8.

In light of the above, a Notice of Allowance is solicited.

In the event that the transmittal letter is separated from this document and the Patent and Trademark Office determines that an extension and/or other relief is required, applicants petition for any required relief including extensions of time and authorize the Commissioner to charge the cost of such petitions and/or other fees due in connection with the filing of this document to **Deposit Account No. 03-1952**, referencing Docket No. 492322002600.

Respectfully submitted,

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